



MAGNET ENGINEERING, FABRICATION and ASSEMBLY

BERKELEY LAB

August 5-6, 2003

*Superconducting Magnet
Program*

Ray Hafalia, Jr.

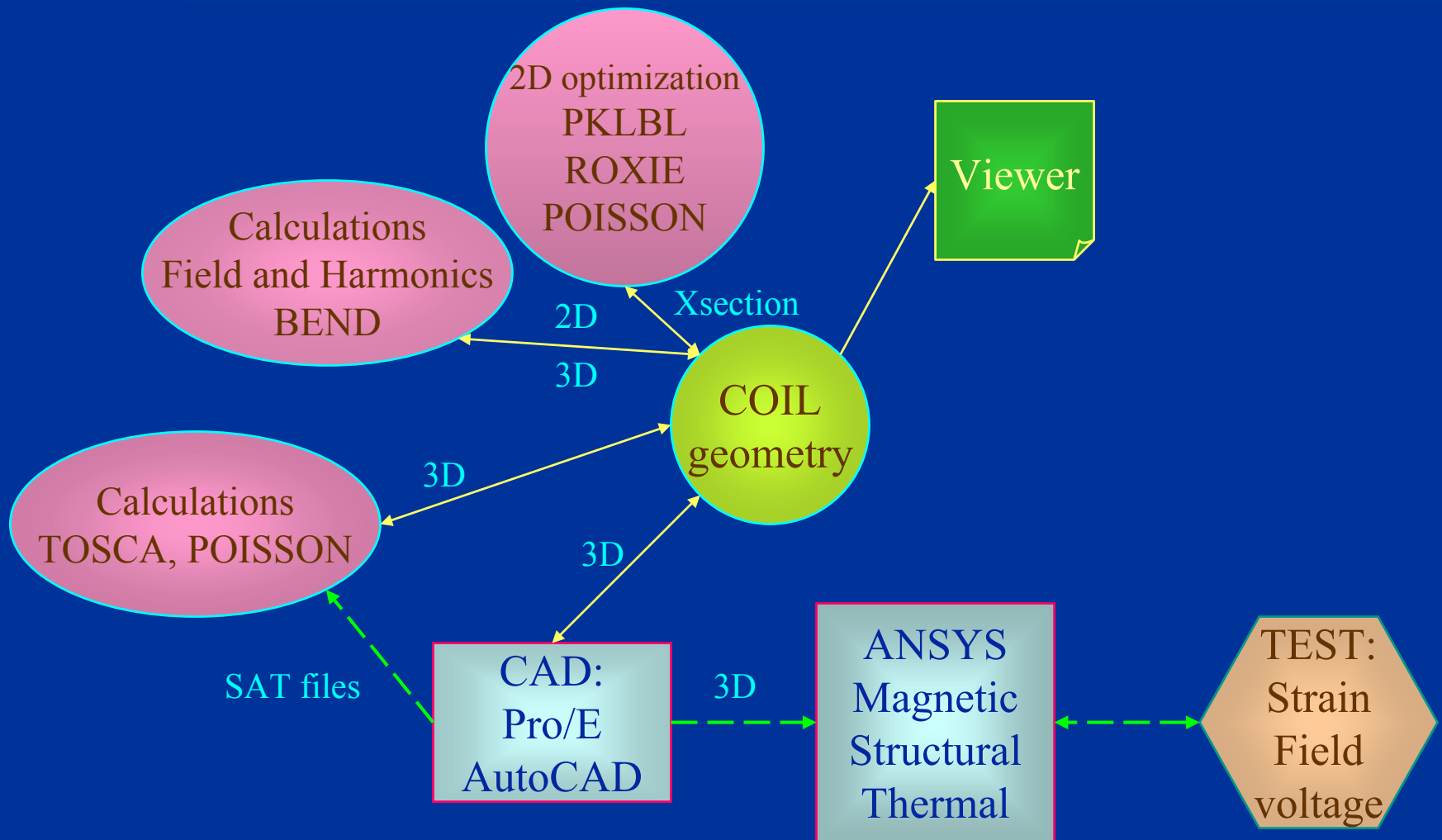


Engineering Design Philosophy

- ❑ *An R&D SC magnet can be fully engineered and cost effective.*
- ❑ *As part of our R&D effort we develop integrated "tools".*
 - ❑ *Coil CAD model generator*
 - ❑ *Links between CAD software to Structural and Field Analysis Codes*
- ❑ *Having incorporated such "tools" into our design process, we are building more structurally sound and magnetically predictable magnets in less time.*



Engineering and Analysis



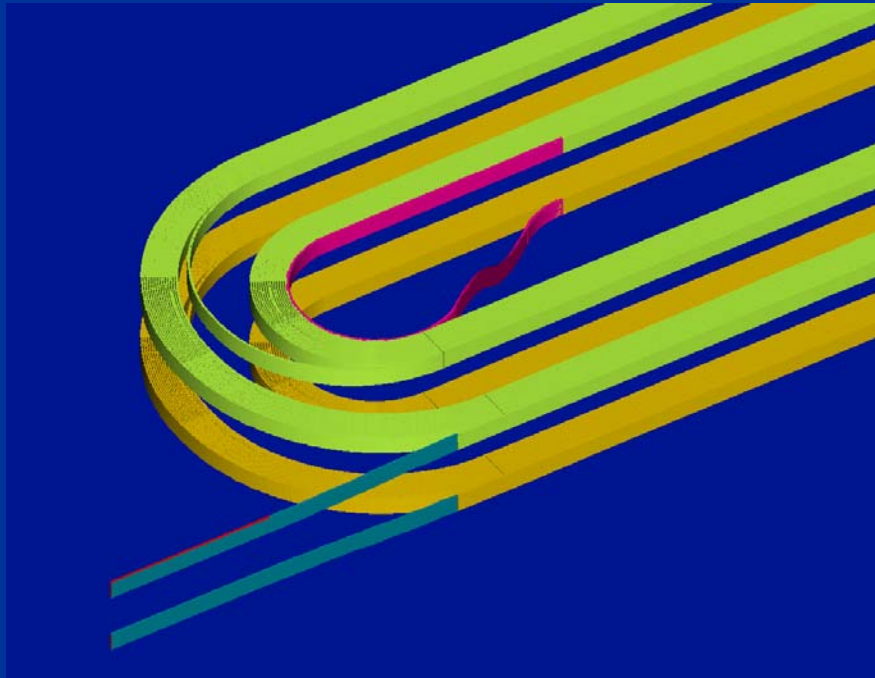
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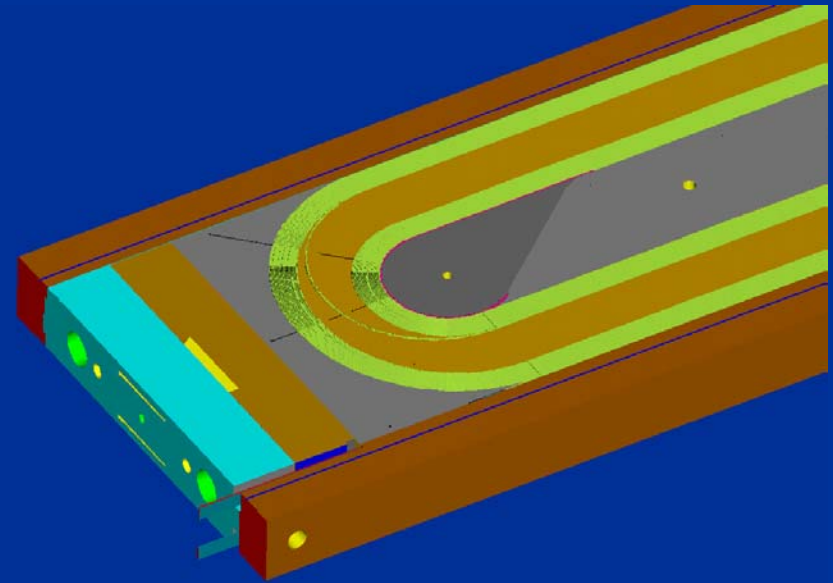
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Magnet Structure based on 3D Coil Model

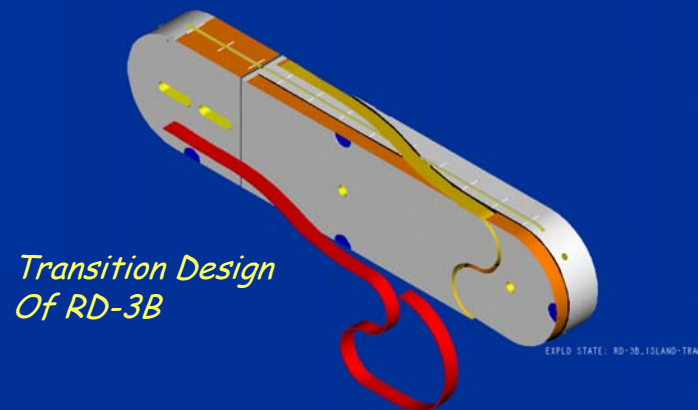
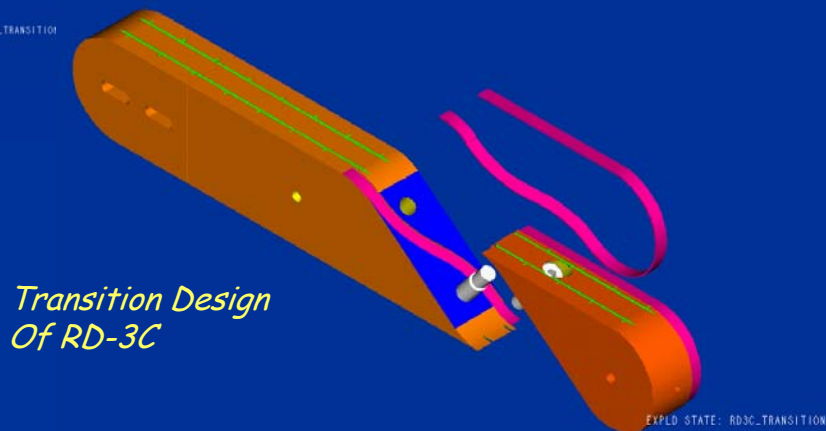
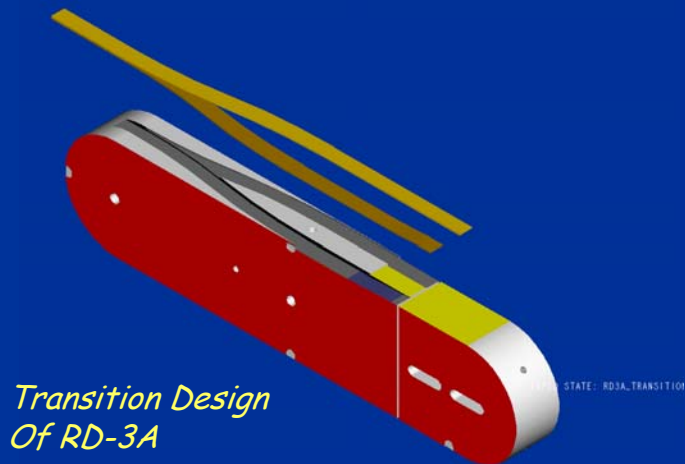


Complete coil CAD model

Structure is designed around coil surfaces



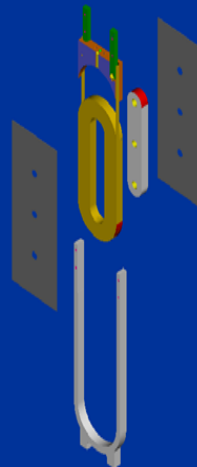
Layer-to-Layer Transition Designs



Design Enhancements



Subscale Coil Module

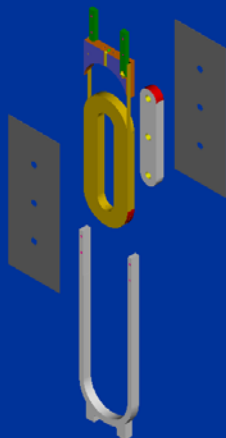
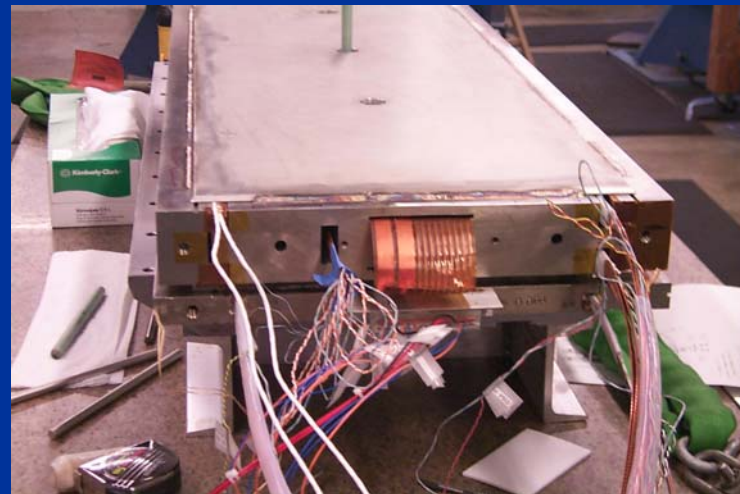


Design Enhancements

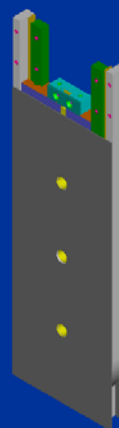


*RD-3 Coil Module
Pre-stressing*

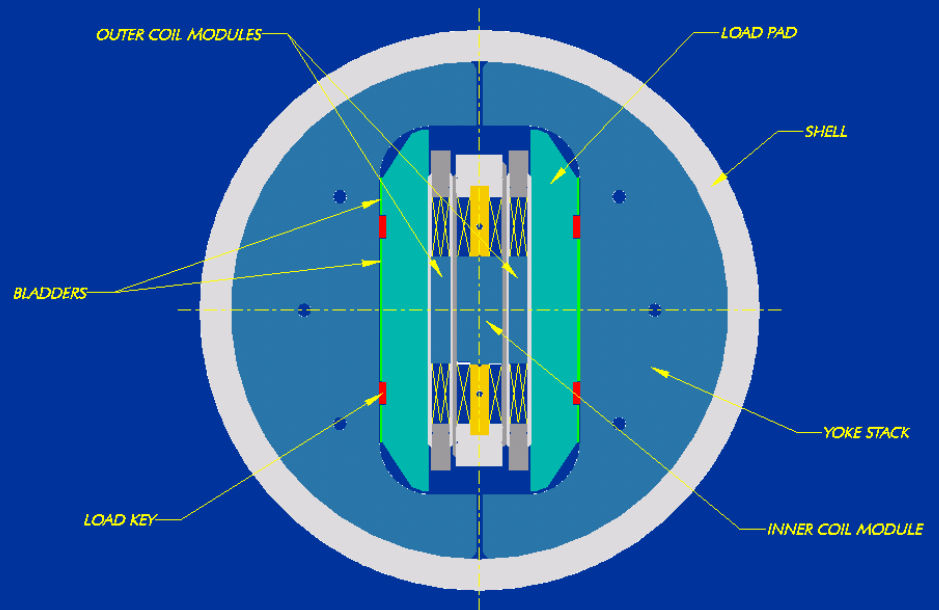
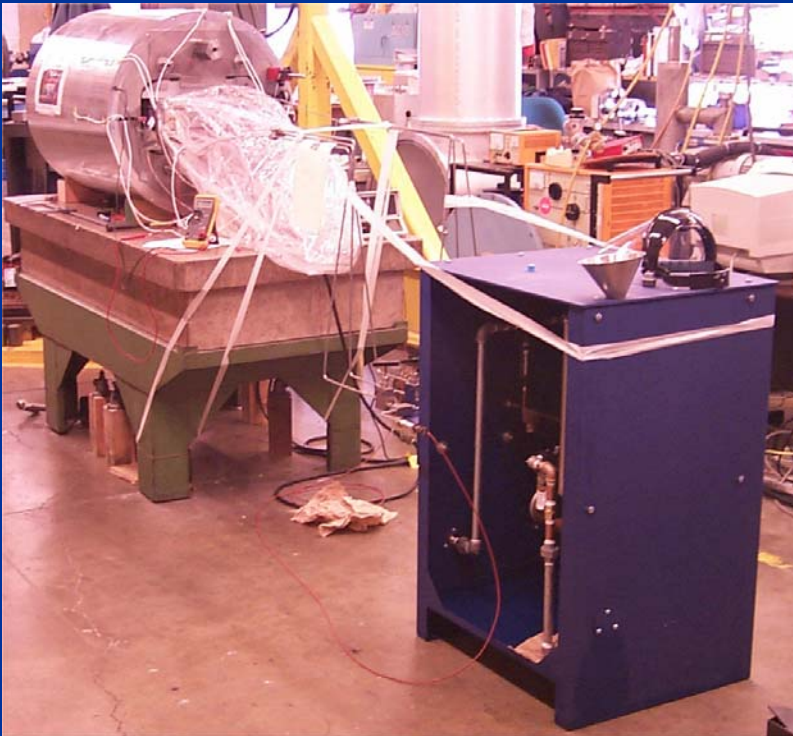
*RD-3 Coil Module
Skinned*



Subscale Coil Module



Bladder & Key Technology



SCALE : 0.100 TYPE : ASSEM NAME : RD3.TOP_ASSY SIZE : A SHEET 3 OF 3

Bladder & Key Technology

*10,000psi Air-driven Pump
For Large-scale Magnet Bladders*



*10,000psi Hand-Operated Pump
For Subscale Magnet Bladders*



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Bladder & Key Technology

BLADDERS

- 2 Sheets, 0.25mm thick 304 SS+I
- Laser welded
- 0.125" OD Hi-pressure feed tube

Pressurizing Bladders to 69 MPa [10,000 psi] :

TEST COUPON

- 0.27 MN [60,400 lbs]

SUB-SCALE LOADING STRUCTURE

- 1.27 MN [283,000 lbs]

AUXILIARY BLADDER, FULL SCALE LOADING STRUCTURE

- 2.75 MN [618,000 lbs]

MAIN BLADDER, FULL SCALE LOADING STRUCTURE

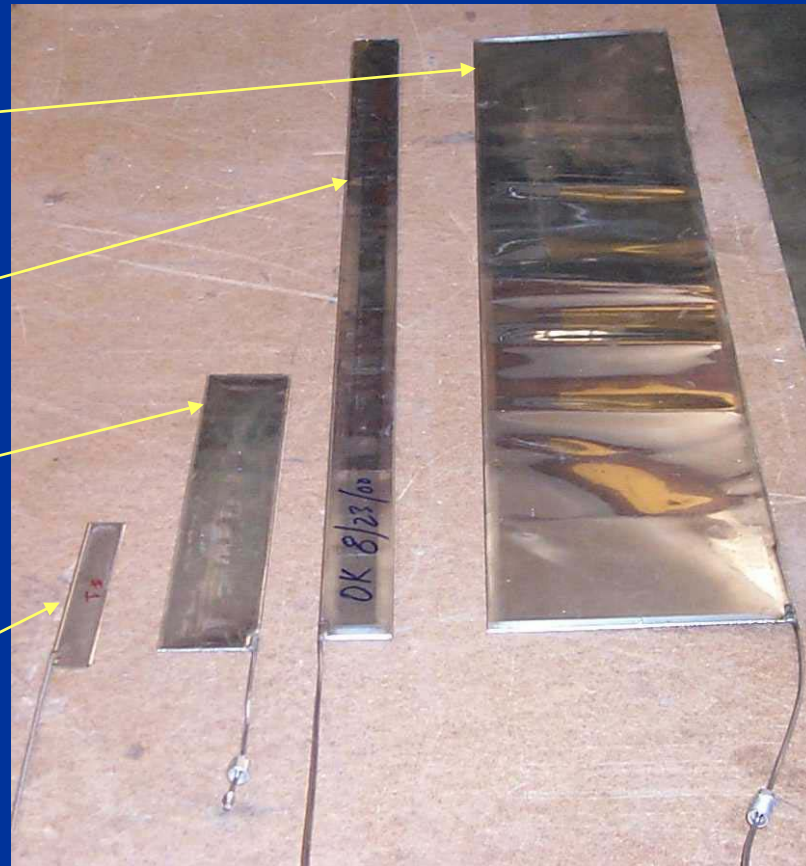
- 11.1 MN [2,500,000 lbs]

184.1 x 875.8 mm
[7.25" x 34.5"]

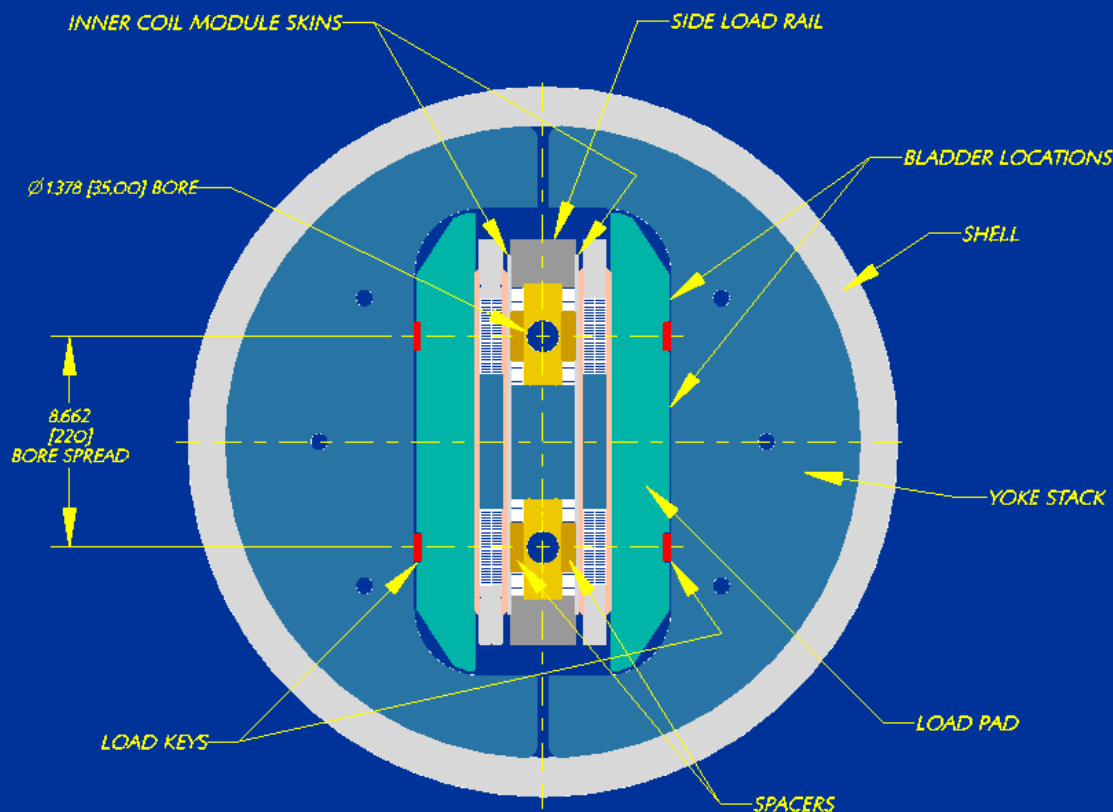
45.5 x 875.8 mm
[1.8" x 34.5"]

60.3 x 304.8 mm
[2.38" x 12.0"]

25.4 x 152.4 mm
[1.0" x 6.0"]



RD-series, 1-Axis Bladder & Key Technology



SCALE : 3/50 TYPE : ASSEM NAME : RD3C_MAG_STRUCTURE SIZE : C

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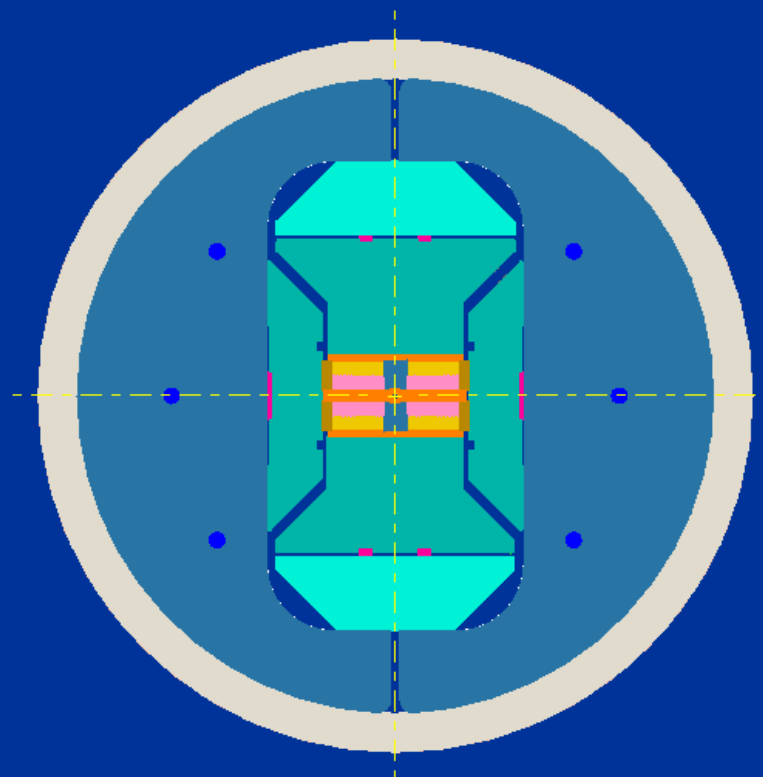
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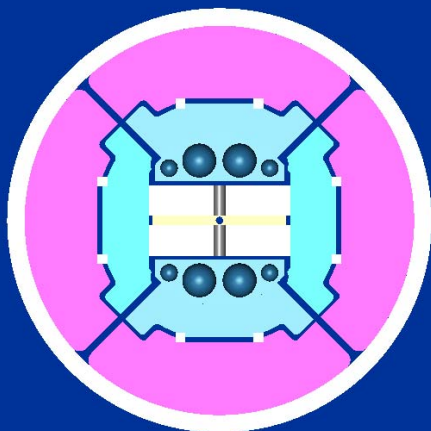
HD-1, 2-Axis Bladder & Key Technology

*RD-3 Aluminum Cylindrical Shell
740mm [29.13"] OD x 42.0mm [1.65"] wall*



*HD-1 in RD-series
Loading Structure*

*HD-1 Aluminum Cylindrical Shell
436mm [17.18"] OD x 17.5mm [.69"] wall*



*Conceptual Design of HD-1
Dedicated Loading Structure*

ANSYS 3-D Analysis of HD-1

1

NODAL SOLUTION

TIME=9.00

UZ (AVG)

RSYS=0

DMX =1.07

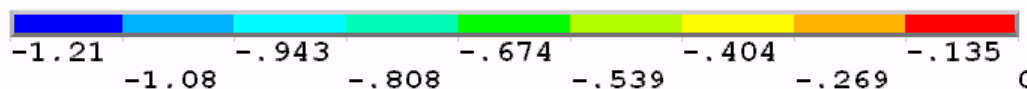
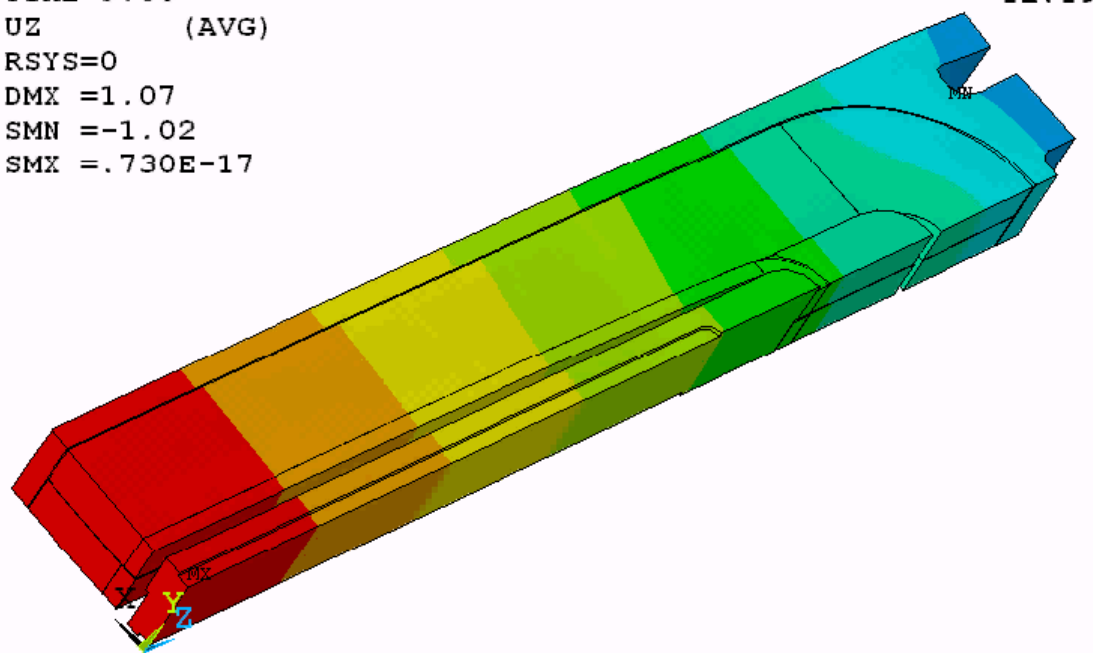
SMN =-1.02

SMX =.730E-17

ANSYS

APR 30 2003

12:19:27



Data in consistent DesignSpace NMM units

CoilsUz

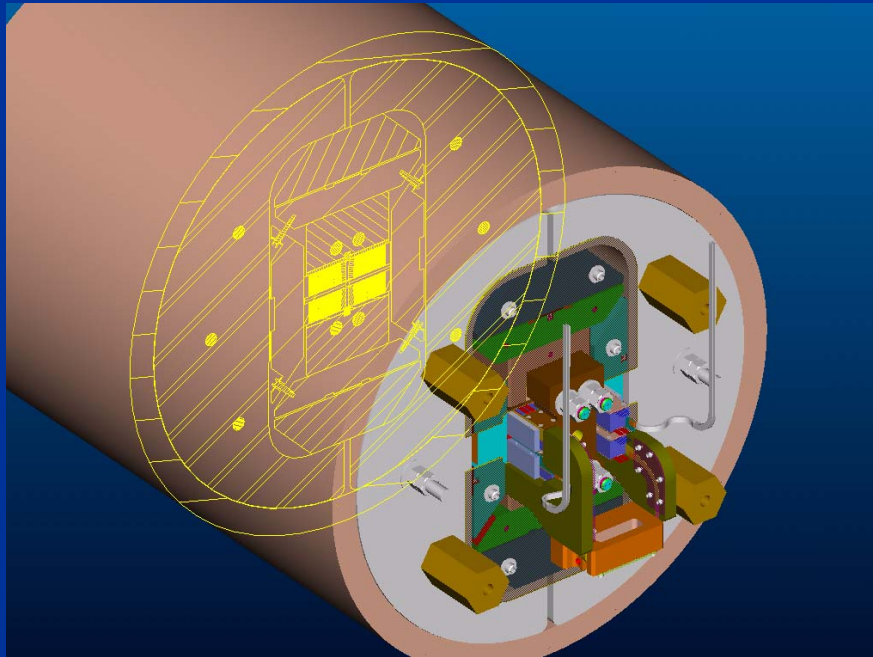
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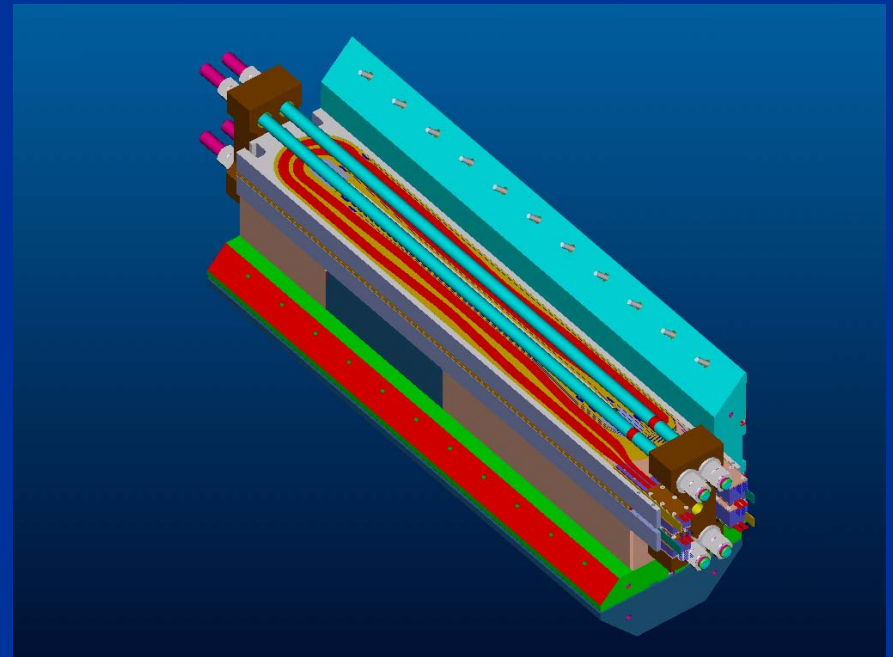
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HD-1, 3-Axis Loading



HD-1 top assembly, Lead End



HD-1 Z-Load Tie-Rods